High Precision Performance Measurement of Network Device

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Introduction

Existance of highly latency sensitive online services such as Online Games (e.g., FPS, RTS) and Online Communication services (e.g., Skype)

Need for measurement of network devices' performance at fine resolution and accuracy

Problems with Conventional Technology

- Software implementation, accompanies dynamics and distortions, caused by interruptions, bus and buffering mechanisms, leads to imprecision and inaccuracy
- NICs (most GigE) use Interrupt Coalescence which leave burst “signature” on network measurements of packet intervals and delay
- Hardware, designed for network device measurement, are very expensive and lack flexibility.

Software's Imprecision

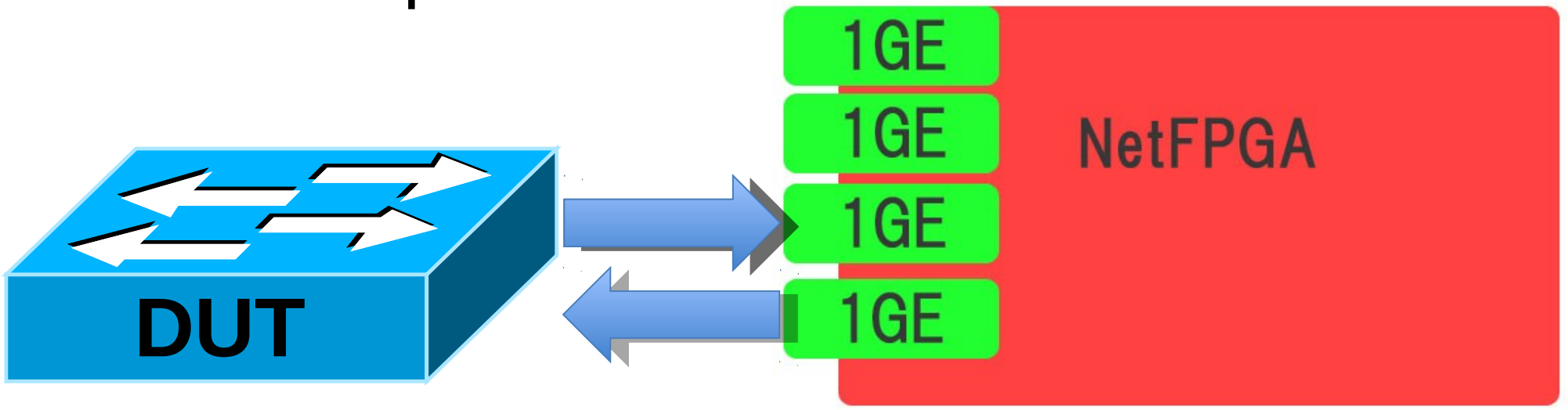
```
File  Edit  View  Search  Terminal  Help
[bhangra@bhangra tmp]$ ping localhost
PING localhost (127.0.0.1) 56(84) bytes of data.
64 bytes from localhost (127.0.0.1): icmp_req=1 ttl=64 time=0.055 ms
64 bytes from localhost (127.0.0.1): icmp_req=2 ttl=64 time=0.057 ms
64 bytes from localhost (127.0.0.1): icmp_req=3 ttl=64 time=0.057 ms
64 bytes from localhost (127.0.0.1): icmp_req=4 ttl=64 time=0.060 ms
64 bytes from localhost (127.0.0.1): icmp_req=5 ttl=64 time=0.065 ms
64 bytes from localhost (127.0.0.1): icmp_req=6 ttl=64 time=0.057 ms
64 bytes from localhost (127.0.0.1): icmp_req=7 ttl=64 time=0.043 ms
64 bytes from localhost (127.0.0.1): icmp_req=8 ttl=64 time=0.053 ms
64 bytes from localhost (127.0.0.1): icmp_req=9 ttl=64 time=0.051 ms
64 bytes from localhost (127.0.0.1): icmp_req=10 ttl=64 time=0.044 ms
64 bytes from localhost (127.0.0.1): icmp_req=11 ttl=64 time=0.069 ms
64 bytes from localhost (127.0.0.1): icmp_req=12 ttl=64 time=0.061 ms
64 bytes from localhost (127.0.0.1): icmp_req=13 ttl=64 time=0.056 ms
64 bytes from localhost (127.0.0.1): icmp_req=14 ttl=64 time=0.055 ms
64 bytes from localhost (127.0.0.1): icmp_req=15 ttl=64 time=0.048 ms
64 bytes from localhost (127.0.0.1): icmp_req=16 ttl=64 time=0.048 ms
^C
```

Overview

Implement high precision network device tester

Prove the implementation’s precision

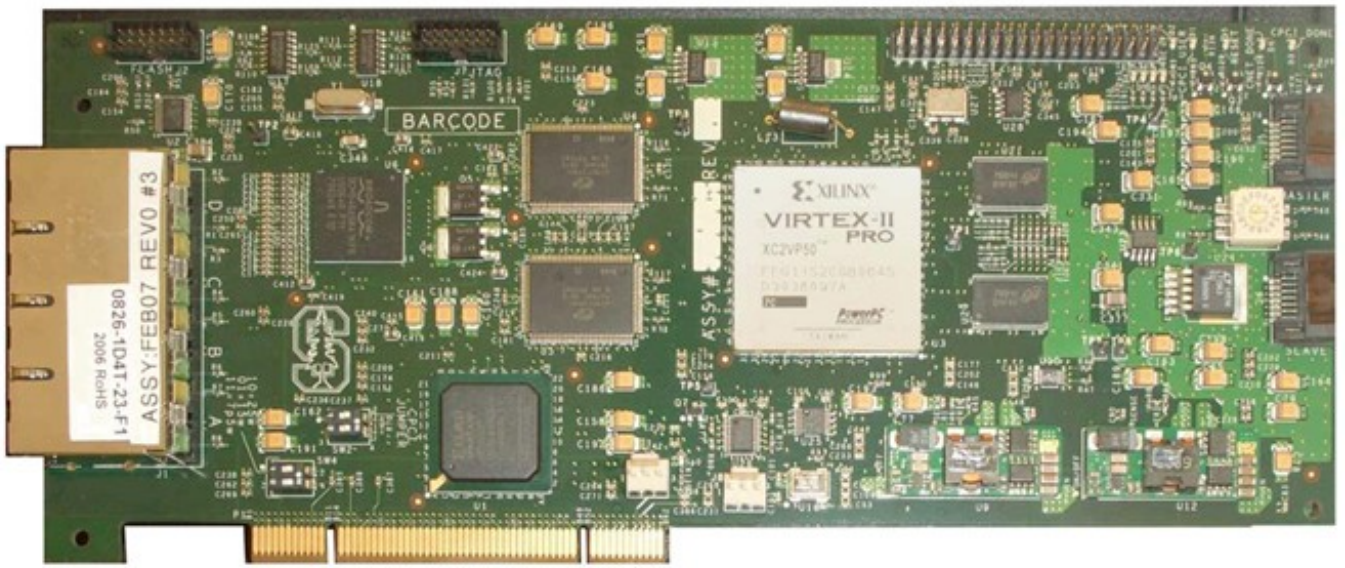
Measure performance of L3 switch.



NetFPGA

PCI card with 4 gigabit Ethernet(GE) interface, PHY, SRAM, DRAM, etc.

It is designed to operate on 125MHz clock, rate at which 1 byte is sent on GE.

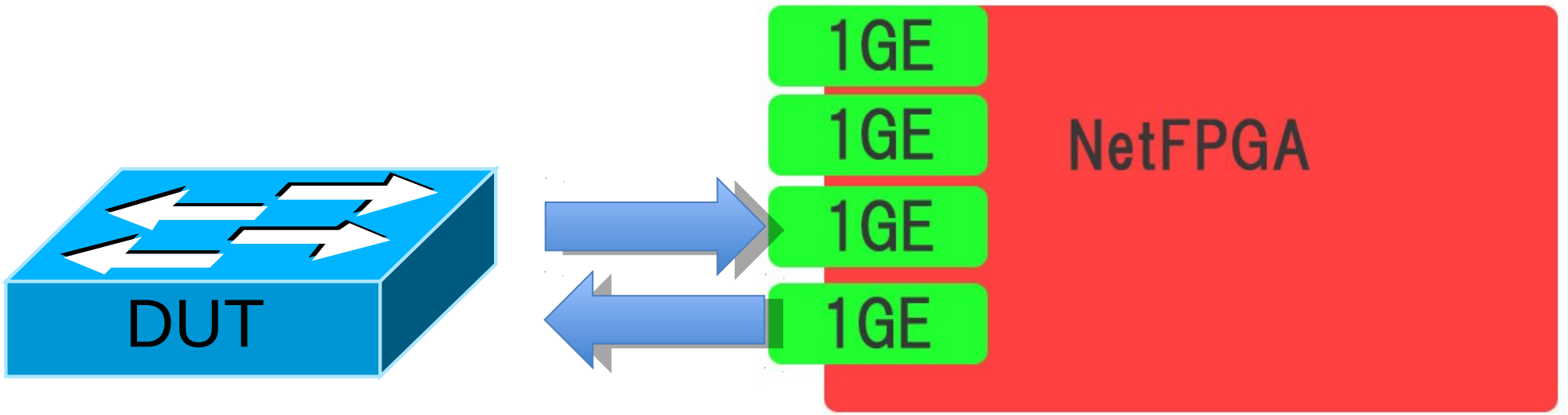


Implementation

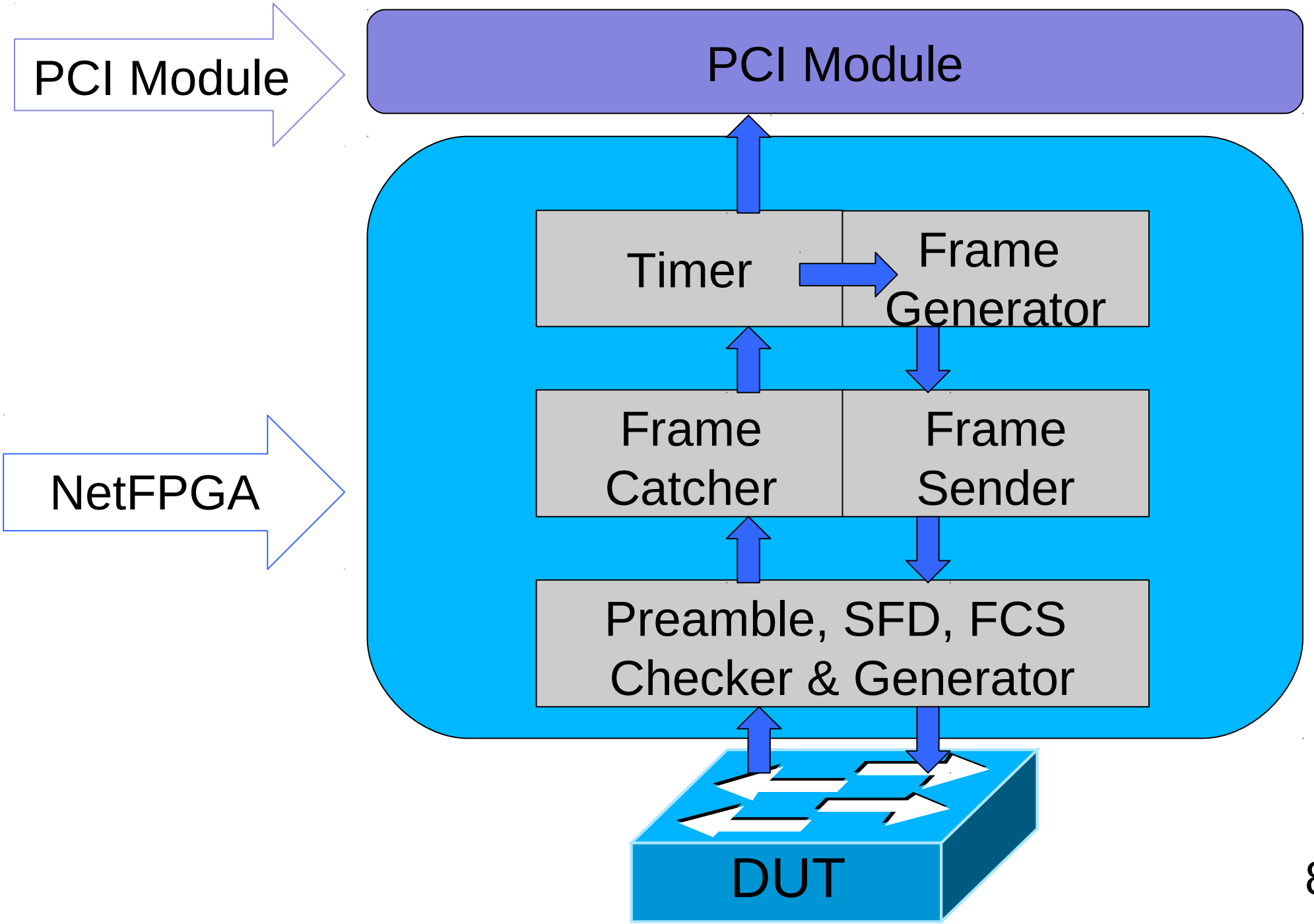
Send ether frame from an interface to DUT and receive it with another interface.

Calculate the elapsed time from time stamp for sending and receiving.

Transmit the data to PC from PCI interface.



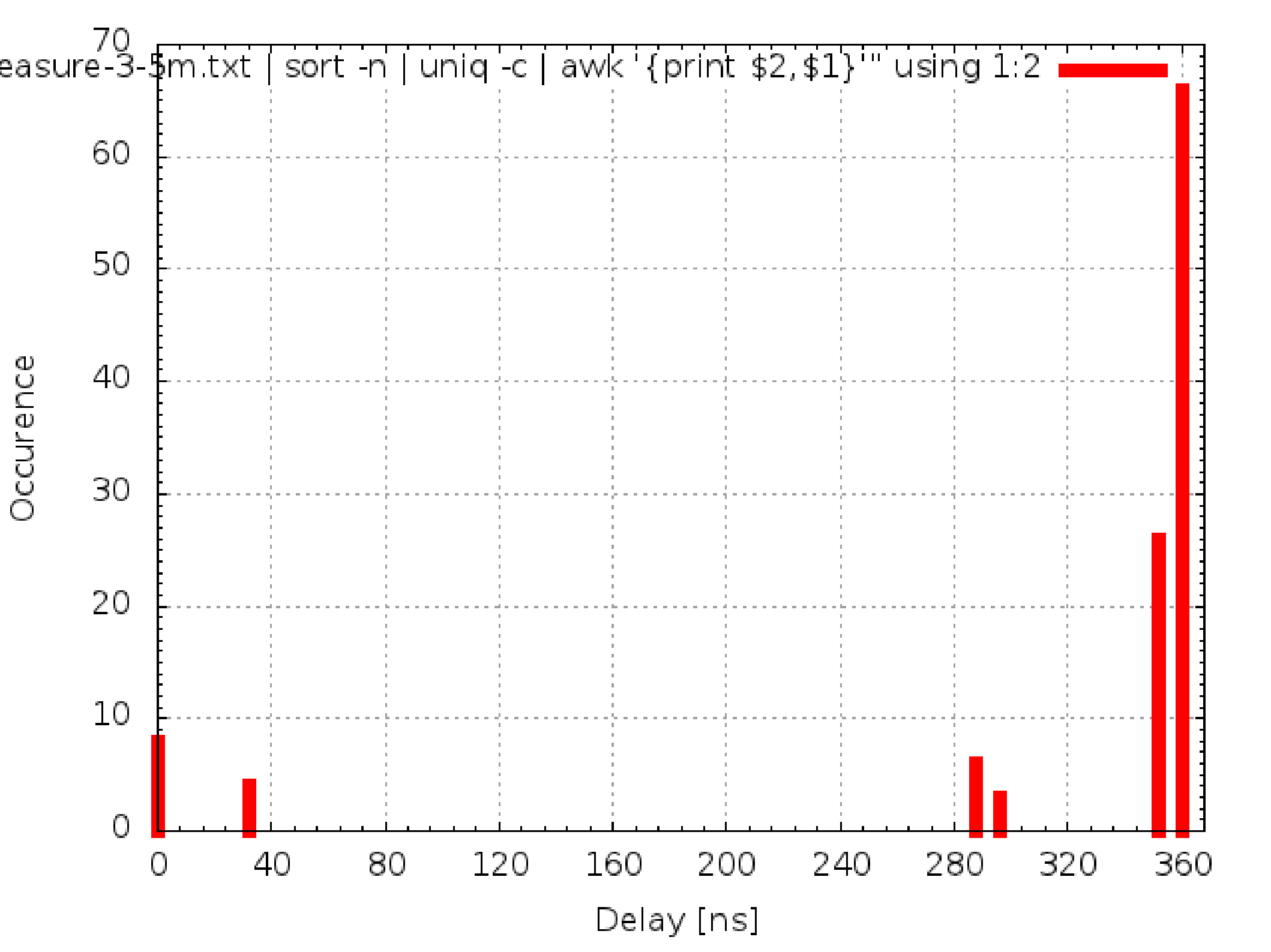
Implementation



Progress

- Success with sending Ether frame through module that generates Preamble, SFD and CRC.

- Measurement has been carried on, however there were some bugs and deviance with data recorded.


easure-3-5m.txt | sort -n | uniq -c | awk '{print $2,$1}'" using 1:2
Occurence
Delay [ns]
0
10
20
30
40
50
60
70
0
40
80
120
160
200
240
280
320
360

Evaluation

Evaluation Criteria

- Test the implementation's precision
- DUT's data which has been measured with the implementation:
  - Internal Latency
  - Frame Drop Rate

Verification Condition

2 verification conditions are presumed:

1. Measure implementation’s internal latency and test the precision of implementation
2. Check the implementation’s accuracy and by measuring with a long UTP cable and compare the latency measured with

Verification Condition 1

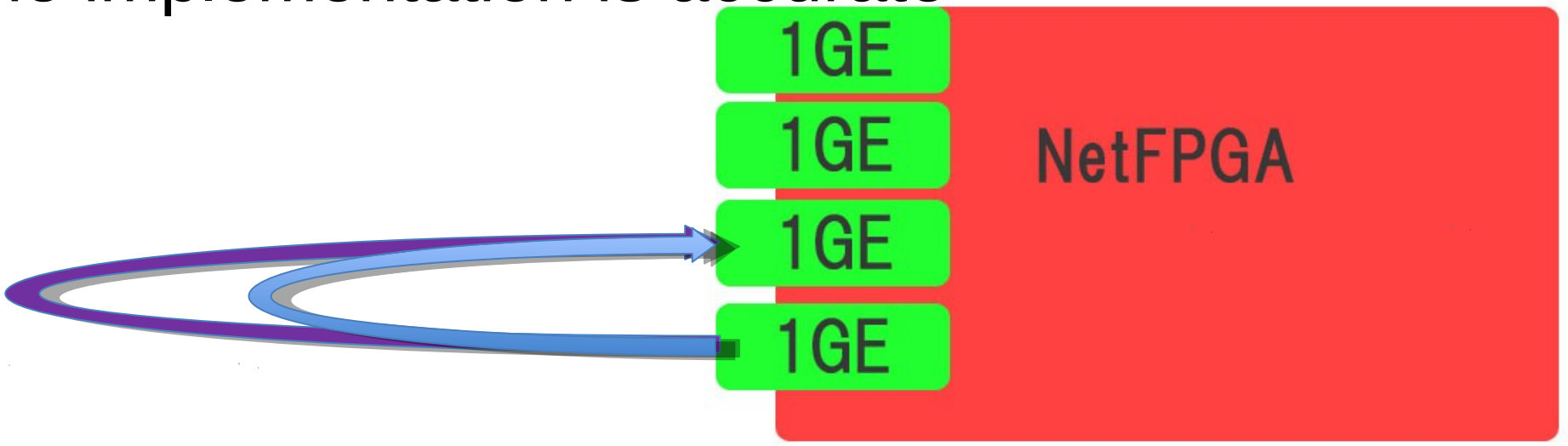
Connect the GE interfaces with a UTP cable

Aim: test internal latency and precision of the implementation

Verification Condition 2

Differing Cable Length

Aim: Compare the latency measured and theoretical value for the latency, in order to see if the implementation is accurate

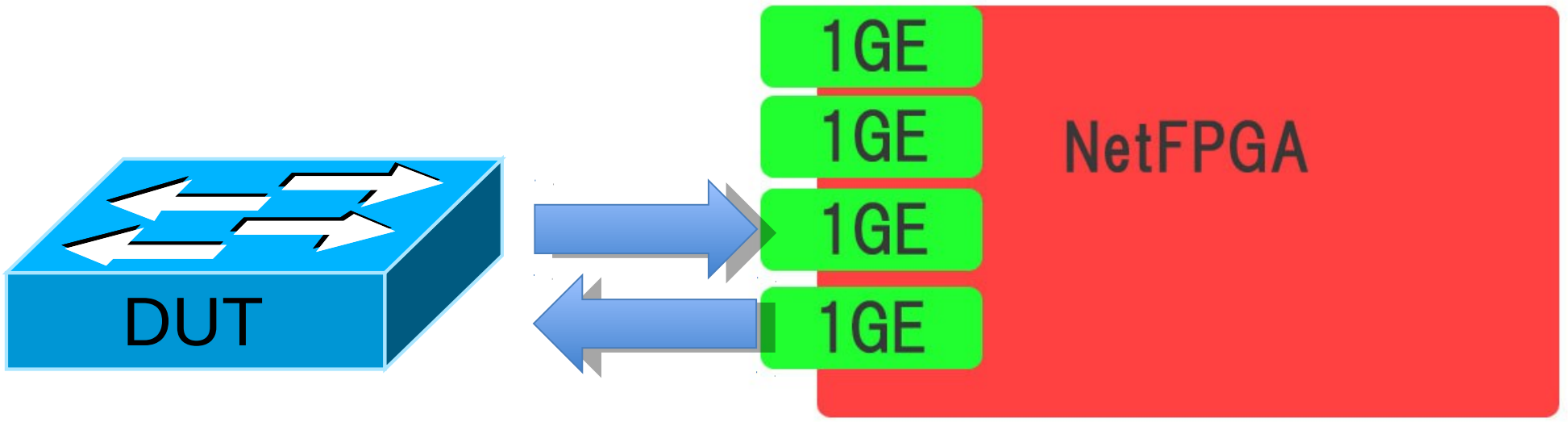


Measurement

Connect implementation with DUT

3 Frame Length: 64 and 1518bytes, jumbo frame

Aim: test internal latency of the DUT and rate at which Ethernet frames are dropped



Schedule

Reference

[1] Itmedia, “ ネットワークスイッチのスループットを調査せよ 【前編】 (1/3)”

http://www.itmedia.co.jp/enterprise/articles/0803/24/n
(2012/1/16 確認)

[2] Ravi Prasad, Manish Jain and Constantinos Dovrolis. (2004). Effects of Interrupt Coalescence on Network Measurements [Online]. Available: www.springerlink.com/content/a6tyk34er2xr6bwm/fu

Summary

Aim:

Implement high precision network device tester with FPGA and measure network devices' performance.

Hardware Bottleneck Evaluation and Analysis of A Software PC-based Router

http://webdocs.cs.ualberta.ca/~qinghua/spects_08_ye.pdf

Introducing scalability in network measurement: toward 10 Gbps with commodity hardware

http://dl.acm.org/citation.cfm?id=1028818

Instrumentation for exact packet timings in networks

http://dfreedman.cs.cornell.edu/BiFocals_I2MTC11.pdf

Passive and Active Network Measurement

http://books.google.co.jp/books?id=t60_xTVn15gC&pg=PA30